Wastewater Treatment Division
Computer Systems Planning Study
Final Report

September 2002

King County

Department of Natural Resources and Parks
Wastewater Treatment Division
201 South Jackson Street
Seattle, WA 98104-3855

Computer System Planning Study

for

King County
Wastewater Treatment Division

September 2002
Westin Project Number 6251

Submitted to:

Mr. Adé Franklin
Department of Natural Resources
King Street Center
201 S. Jackson Street
M/S KSC-NR-0509
Seattle, WA 98104

Prepared by Westin staff:

Gary Kerker
Project Consultant

Rod vanBuskirk
Project Consultant

Ron Lauer
Project Manager

Dave Roberts
Quality Control

Westin
11150 International Drive, Suite 200
Rancho Cordova, CA 95670

Appendices

Tables

Figures

EXECUTIVE SUMMARY

Introduction

The King County Wastewater Treatment Division (WTD) has invested nearly $80 million over the past 15 years to build and maintain its computer infrastructure, which now consists of some 75 applications. Westin Engineering, Inc., a consultant to WTD, has identified substantial savings that have occurred as a result. Westin estimates that without this stated technology investment, WTD's current operations budget would be approximately 25 percent larger. This represents a substantial savings and clearly indicates that these past technology investments resulted from sound business decisions.

Many of these computer systems have now reached an age at which they must be replaced soon so that WTD can continue to operate at its current level of efficiency, maintaining its target of one overflow event per site per year. In addition, new computer systems have been proposed to support new WTD programs, meet regulatory requirements, and increase the Division's level of operating efficiency.

Faced with aging computer systems that threaten efficient and safe operation, the Division is poised to make a decision for the implementation of replacement and new systems according to a planned approach. Such an approach would result in an integrated computer infrastructure and would move WTD ever closer to its two long-term goals of:

- Becoming one of the best publicly operated wastewater utilities by 2005
- Being competitive with private sector wastewater utilities by 2010.

To make gains in efficiency and competitiveness, WTD must do more than simply install new computer systems. These hardware and software purchases must be combined with changes in business practices that take advantage of the new tools.

In the preservation of and improvements to its computer infrastructure, WTD management will need to provide several forms of support:

- Financial support to purchase and implement recommended systems
- Support for changing business practices to take advantage of new opportunities for efficiency
- Adoption of a program implementation strategy that will begin today to build an integrated system.

This Executive Summary explains the work that Westin and WTD have undertaken to conduct a Computer Systems Planning Study and develop a Computer Systems Master Plan. It provides an overview of the Study and its findings, program recommendations, benefits, implementation strategies and timelines, and financial analyses.

Project Background

WTD retained Westin Engineering to conduct a Computer Systems Planning Study that would:

1. Assess the condition of WTD's computer assets and determine their risk of failure.
2. Create a plan that will coordinate computer investments to create an integrated computer infrastructure.
3. Establish process standards for WTD computer projects.
4. Establish standards for WTD computer systems.

The results of this study are documented in this Computer Systems Master Plan, which consists of the following elements:

- Executive Summary
- Master Plan
- Appendix A – Cost Avoidance Benefits
- Appendix B – IT Staffing
- Appendix C – IT Standards
- Appendix D – IT Architecture
- Appendix E – Existing Condition Assessment
- Appendix F – Projects and Subprojects

Westin Engineering initiated the Computer Systems Planning Study by conducting a series of workshops and interviews. During this process, Westin collected a large amount of information about the current computer systems, the users' perceived view of these systems, the current condition of these systems, risks associated with potential system failures and the level of investment that has been made in these systems. Westin also collected information about unmet needs and new requirements for computer systems that have not been acquired.

Existing Systems Assessment

The Study included a detailed inventory of the existing applications and the computer systems supporting those applications. For the purpose of documenting these existing systems in the Master Plan, a diagram was developed that organized the existing computer systems by function, indicated the connectivity between systems, identified how each system is supported and categorized the condition of each system. This diagram is represented as Figure ES-1. Color coding was utilized to highlight significant findings of the study. Systems represented with a red bar across the top of the box indicate systems that are in need of immediate attention. Likewise, the line pattern used to connect applications and systems indicates the degree of automated connectivity between systems. The absence of solid black lines terminating with an arrow, indicates the low level of integration in the existing environment and the high degree of manual interface or data transfer.

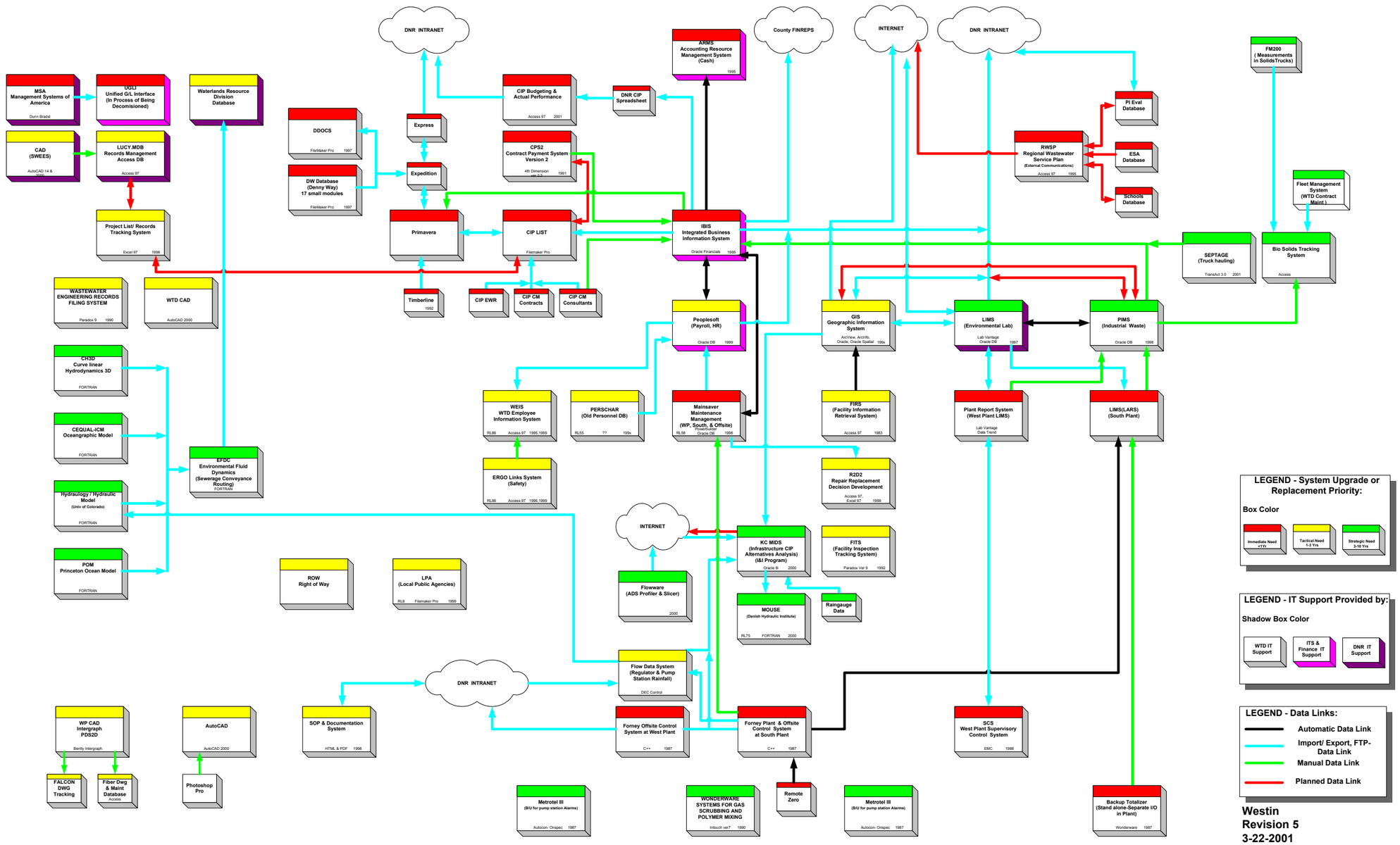


Figure ES-1: Current System Assessment

The high degree to which systems need immediate attention and the low level of integration is symptomatic of implementing technology without the benefit of a comprehensive master plan for technology. However, this condition is not unusual. When many of these systems were implemented, the need for long range technology planning was not clearly understood in the industry. Many of the Division's systems are simply suffering from the effects of age and the growing complexity of operating a large wastewater operation. Furthermore, when many of these systems were acquired, there was not a clear understanding of the level of integration that was both possible and desirable. Despite the condition of many of these systems and the lack of automated integration, these systems still represent a wise investment by the Division and have substantially reduced the ongoing costs of operating the Division.

Needs Assessment

After the current condition of WTD computer systems was assessed, a series of needs assessment workshops were conducted that resulted in establishing the Division's prioritized needs. These needs were then analyzed and allocated to the improvement initiatives shown in Figure ES-2.

Figure ES-2: Improvement Initiatives

Risk Assessment

The Risk Assessment process determined the condition of individual computer systems and the computer network as a whole. The process also assessed the ability of the existing systems to meet current and future needs of the Division. Lastly, the process evaluated the potential for system failure and the consequences of that failure. For the purposes of this Master Plan, a failure is defined as the inability of an existing system to meet the current or future functional needs of the Division, as well as the potential for hardware and software failures.

Table ES-1 shows the events that were used to determine the potential for failure and the consequences of failure associated with the existing computer systems and their ability to meet the needs of WTD.

Table ES-1: Potential for Failure/Consequences of Failure

High Potential for Failure	High Consequence of Failure
• Critical hardware or software component failures or obsolescence within 2 years. • New regulations require additional functionality from existing systems within 2 years. • New internal policies or sections within the Division require additional functionality from existing systems or new systems within in 2 years.	• Severe impact on the ability of the Division to complete primary objectives. • Negative impacts to public health and safety, 75% or higher chance of overflow event. • Significant damage to critical infrastructure assets.
Medium Potential for Failure	**Medium Consequence of Failure**
• Critical hardware or software component failures or obsolescence within 5 years. • New regulations require additional functionality from existing systems within 5 years. • New internal policies or sections within the Division require additional functionality from existing systems or new systems within 5 years.	• Impact on the ability of the Division to complete primary objectives. • Negative impacts to public health and safety, 50% - 75% chance of overflow event. • Minimal damage to critical infrastructure assets.
Low Potential for Failure	**Low Consequence of Failure**
• Critical hardware or software component failures or obsolescence within 10 years. • New regulations require additional functionality from existing systems within 10 years. • New internal policies or sections within the Division require additional functionality from existing systems or new systems within 10 years.	• Minimal impact on the ability of the Division to complete primary objectives. • Negative impacts to public health and safety, less than 50% chance of overflow event. • No damage to critical infrastructure assets.
Criticality or Risk Factor	
This element considers the Potential and Consequence of Failure of an existing system to determine the criticality of the project.	

Computer system solution alternatives were developed and a solution architecture was selected. Using this architecture as a technology framework, the Improvement Initiatives shown in Figure ES-2 were transformed into nine major projects and 45 subprojects. An assessment of the existing systems, plus the criticality/risk analysis was utilized to develop an initial list of potential replacement and new computer systems projects. Westin then developed an implementation strategy and project costs per WTD capital planning budget procedures for each of the projects.

A total of nine high priority projects were identified; four were replacement projects and five were new systems projects. The following graphic, Table ES-2: Criticality/Risk Factors, summarizes the potential for failure, the consequences of failure and the criticality/risk factor for each of the nine major projects identified in the Master Plan.

Table ES-2: Criticality/Risk Factors

Project Name	Potential of Failure	Consequence of Failure	Critically/ Risk Factor
Replacement Projects			
Plant and Conveyance Control Systems	High	High	High
Project Control Systems	High	High	High
Water Quality Systems	High	High	High
WAN & LAN Upgrades	Low	High	Medium
New Projects			
New Plant and Conveyance Control Systems	Medium	High	High
Water Quality Database	Low	Medium	Medium
Asset and Maintenance Management Systems	Medium	High	High
Data Management Systems	Medium	Medium	Medium
Network Enhancement Projects	Low	Medium	Medium

The time needed to design and implement technology projects is key in the consideration of criticality/risk factors. In general, technology projects should begin approximately two years before an anticipated failure. This fact has generated significant concern for the plant and conveyance control systems. These systems are technically complicated and have the highest risk of failure due to age and obsolescence. The Plant and Conveyance Control System Project represents a serious exposure for system failure for the Division.

Program Recommendations

A productivity analysis was performed to determine project benefits and a series of management presentations were made to gain approval to proceed with the resultant Computer Systems Master Plan. As a result, the 45 subprojects originally identified were reduced to 29 that have been assigned to nine larger projects according to their function and priority.

These nine projects make up the Master Plan and are recommended for implementation as described in Table ES-3: Recommended Projects. The 29 subprojects are more manageable, have precise deliverables and are organized to incrementally complete the goals of the project. Sections 3 through 5 of this document contain more detail on each project and its subprojects. Also, Appendix F contains detailed information for each of the subprojects.

The Computer Systems Master Plan Program has been created to implement the nine improvement projects, focusing on:

- Continued O&M improvement
- Enterprise-wide integration of information
- More effective application and management of Information Technology (IT).

Table ES-3: Recommended Projects

Project Name/Description	Implementation Schedule
Replacement Projects	
Plant & Conveyance Control Projects. Allow staff to operate & control the treatment plants & conveyance regulator & pump stations. This project will maintain, upgrade and replace the existing systems.	2002 to 2008
Project Control Systems. Will allow the Division to meet new program management and reporting requirements. Funding for this project is included in the RWSP; consequently the funds needed to implement this project are not shown. URS is currently contracted to perform this work.	2001 to 2006
Water Quality Systems. Allow staff to collect, analyze and report regulatory compliance data. This project will replace the existing water quality systems.	2007 to 2009
Wide Area Network (WAN) & Local Area Network (LAN) Upgrades. These are the physical components of the Division's computer infrastructure. The actual wires, fiber optic cables, routers & servers allow data to be transferred from point to point. This project will upgrade these components as required.	2004 to 2011
New Computer System Projects	
Brightwater Plant & Conveyance Control Systems. Will allow the computer systems associated with the RWSP to be integrated into the existing systems. The Brightwater plant & conveyance control systems are funded in the RWSP budget.	2007 to 2011
Water Quality Database. Will serve as a warehouse for all water quality data collected in the Wastewater Program.	2007 to 2009
Asset & Maintenance Management Systems. Will provide the computer systems required to implement the new Asset Management Section.	2003 to 2011
Data Management Systems. Will provide the computer systems to manage the Division's documents, specifications & drawings.	2006 to 2011
Network Enhancement Projects. Will provide the computer hardware & software to create an IT architecture that will enhance productivity by providing easy, timely & reliable access to data.	2004 to 2011

Program Rationale

The Replacement Projects are required to continue the cost-effective operation of the Division. The conveyance and treatment of wastewater and the completion of the regulatory reports would be considerably less efficient processes if the Replacement Projects were not completed. Further, replacement of basic system components allows WTD to maintain its target of one overflow event per site per year. Consequently, Westin views the Replacement Projects as mandatory to the continued efficient operations of the Division. The Existing Productivity Benefits subsection below details several benefits of implementing one of the major Replacement Projects: Plant & Conveyance Control Systems.

While implementing these Replacement Projects positions WTD to maintain current levels of efficiency, how they are implemented can contribute to the Division's strides towards achieving its stated 5- and 10-year goals of competitiveness. WTD may choose a planned or unplanned approach of implementation. The planned approach is defined as an implementation strategy that will result in an integrated computer system, while the unplanned approach will result in a computer system that is not integrated. The Planned Versus Unplanned Approach subsection below describes the advantages of a planned approach.

Contributing to both increased efficiency and integrated functionality of WTD systems are the New Computer System Projects. These projects provide the additional technology to streamline and implement new workflow processes. The new functions will support database and system integration, automate workflow tools and eliminate redundant computer systems. The New Productivity Benefits subsection below discusses these new systems and their enhancement capabilities.

The program recommended by Westin Engineering will implement projects that also support the Wastewater Program Balanced Scorecard objectives. The Wastewater Program Balanced Scorecard subsection below provides insight into these benefits.

Existing Productivity Benefits (EPB)

Westin estimates that the operations and maintenance labor cost would increase by 25 percent without the existing level of automation in the plant and conveyance control system. Automation facilitates faster, more effective response time to emergencies and reduces the number and duration of overflow events. The Replacement Project supports the continuation of these existing productivity benefits.

WTD is currently avoiding an estimated $5 million annually as a result of the existing plant and conveyance system operation, monitoring and control automation. Ninety percent of this avoided cost results from the difference in staff required to manually operate, monitor and control the plant and conveyance system versus the current staffing level used to perform these functions.

If the existing plant and conveyance control systems are not replaced the staff will be less prepared to prevent overflow events. This will result in an increase in overflows during storm events. The remaining ten percent of the cost avoidance is associated with the inability of staff to prevent overflows during storm events.

The combined conveyance system in the West Section affects the ability of staff to control wastewater flows during a storm event. While the impact on the East Section is less because the conveyance system is separated, the affect of inflow and infiltration considerably increases flow levels during storm events.

It is clear that more overflows will occur without the plant and conveyance control systems. More overflows would negatively impact public health and safety, increase the financial costs associated with overflows and result in a loss of image and public trust. These negative impacts will hinder the Division in its efforts to meet the target of one overflow event per site per year.

More overflows would also impair the Divisions ability to meet their stated goals of becoming one of the best public wastewater utilities in the next five years and becoming competitive with the private sector in the next ten years.

To maintain these existing productivity benefits, the Division should continue to maintain and upgrade existing computer systems and complete the recommended Replacement Projects.

Planned Versus Unplanned Approach

The planned approach is defined as an implementation strategy that will result in an integrated computer system, while the unplanned approach will result in a computer system that is not integrated. In the past the Division has responded to its technology needs in an ad hoc fashion, initiating an IT project when the need arose for additional functionality. Over the past ten years this methodology has created the existing computer infrastructure that includes over seventy computer systems.

Developing computer infrastructure in this fashion has been common practice in the Wastewater Industry during the past ten years. Today, utilities are using a more planned approach to avoid developing redundant systems, ensure that users' needs are identified and met, to the extent possible, and to create integrated networks that use common design standards. Some of the benefits of a planned implementation strategy and its resultant integrated system include:

- Greater opportunity to schedule projects and smooth annual project costs
- Forecasting that ensures systems do not reach critical failure conditions
- Allowing staff to access data directly rather than through other employees
- Providing higher quality information that will reduce the number of site visits when information can be obtained via the network
- Allowing software and hardware to be standardized
- Staff-flexibility increases due to the commonality of equipment allowing staff to support multiple system in different work groups or sections
- Improving system reliability to reduce operation and maintenance costs on the system.

The initial cost savings (approximately 10 percent) achieved during implementation in an unplanned manner are exceeded by the cost to manage and maintain disparate systems, the additional time required to manually or semi-automatically transfer information and the additional cost associated with the unintentional development of redundant systems. Beyond these hard costs, the ability of the Division to increase staff efficiency, streamline workflows and monitor and measure costs diminish with computer systems that are not integrated. Integrating computer systems after they have been installed would cost 50 percent more than implementing a planned integrated computer network.

New Productivity Benefits (NPB)

These are benefits that could result from the successful implementation of the program's New Computer System Projects and related business practices that provide the following:

- Improved asset and maintenance management programs
- Reduced asset-related expenditures
- A Master Facilities database to document existing systems
- Reduction in the number of change orders
- Network enhancements - physical improvements to the IT architecture that will provide easy, timely and reliable access to accurate, relevant information.

Westin Engineering estimates that by implementing the Master Plan recommendations relating to Asset, Maintenance and Data Management, the Division will avoid $8.75 million in costs over the next ten years. These systems are essential to the success of the new Asset Management Section and provide the computer systems to implement improved asset and maintenance management programs.

The Environmental Protection Agency (EPA) estimates that asset and maintenance programs can reduce asset-related expenditures by twenty percent. Westin estimates that the asset and maintenance management systems will allow the Division to avoid $7.35 million in costs over the next ten years in the Asset Management Program. However, it must be noted that these avoided costs are not achieved from simply installing new computer systems. The Division must implement new business practices that utilize optimized decision making tools to determine the maintenance, repair and replacement schedules for assets. The new business practices will actually create the cost avoidance; the computer systems recommended in the Master Plan are the tools that will enable new business practices to be implemented.

The Data Management Systems will build upon existing systems to develop a Master Facilities database that will maintain accurate drawing specifications and O&M Manuals for every facility in the Division. A Master Facility database will significantly reduce the time that operations, maintenance and engineering staff spend finding drawings, specifications and O&M manuals. It will also reduce the number of change orders that result from the placement of incorrect drawings into contracts. Over a ten-year period, Westin estimates these avoided costs to amount to almost $1.4 million.

The Network Enhancement Projects will provide physical improvements to the IT architecture that will allow for easy, timely and reliable user access to accurate, relevant information. The project will improve decision making by improving the quality and relevancy of data and the level of confidence that staff have in the data. The project will also provide the incremental modifications to the computer infrastructure that are required over time. Westin estimates the cost avoidance from implementing this project at $3.21 million as a result of reducing the number of new hires required over the next ten years by improving the productivity of its workforce.

Appendix A contains details of the cost avoidance benefits.

Wastewater Program Balanced Scorecard

The recommended projects will install computer systems that also satisfy the Wastewater Program Balanced Scorecard objectives of improving the ability of the Division to monitor and measure goals, meet current and future needs for plant and environmental data and improve engineering and construction services. The following are specific examples of how implementing the recommended projects facilitate Balanced Scorecard objectives. It is not intended to be an exhaustive list of every project.

The Plant and Conveyance Control Projects are required for the continued efficient operation of the Division's conveyance system and treatment plants and are mandatory to meet existing regulatory requirements. The remote monitoring and control that these systems provide is essential to minimizing the number and duration of overflow events, maximizing the storage capacity in existing and future pipelines and establishing an effective predictive control program.

The Water Quality Systems Projects are needed for the Division to continue to meet the regulatory reporting requirements and support the long-term optimization of treatment plant processes. These systems are used to generate the plant process data required by EPA. These systems allow staff to monitor and measure programs to reduce water content in solids, which is important in reducing shipping costs.

The Asset and Maintenance Management System will install the tools required to accurately measure operating, maintenance and engineering labor and material expenditures. This is critical to determining the actual effectiveness of modified- or new-asset and maintenance initiatives. It is also required to track expenditures throughout the year to determine if monthly or quarterly goals are in line with the established goal for the year.

The Data Management System will improve safety by establishing and maintaining accurate as-built drawings and providing easy and reliable access to these drawings. This will allow staff to use as-built drawings to quickly establish and use proper lock-out/tag-out procedures. These systems will lower project costs by reducing the time needed to establish current conditions, create drawings for the project and complete construction by eliminating change orders that result from inaccurate as-built drawings.

The Wide Area Network and Local Area Network and Network Enhancement Projects are the glue that holds the computer infrastructure together. These projects upgrade existing network components and provide new software and hardware that allow staff to access the information needed to complete their primary job function. For example, these projects are needed to allow a person at the King Street Center to monitor an offsite facility or a person at the Environmental Lab to transmit data to technicians at a treatment plant. These projects provide the bandwidth needed to connect staff throughout the Division.

Program Implementation

As discussed previously, the Computer Systems Master Plan is a program that includes:

- Nine improvement projects
  - Focus on improvement
  - Focus on enterprise-wide integration of information
  - Focus on more effective application and management of Information Technology (IT)
- Program Structure
  - Program support office
  - Nine projects and 29 subprojects
  - Training & mentoring of WTD staff.

In order for this program to be a success, its nine improvement projects and any other WTD projects that have significant IT components need to be managed and implemented as a whole. A common set of standards, implementation guidelines and system architecture must be applied to all projects and subprojects that make up the program.

The Computer Systems Master Plan, therefore, also includes:

- Phased Implementation
  - Phased to achieve WTD goals
  - Phased to match organizational and funding constraints
  - Phased to match WTD priorities: immediate, tactical, and strategic needs
- Outsourcing as much as possible to minimize the impact on WTD staff
  - Program needs to support the recent reduction in the size of the organization
  - Program needs to outsource where it makes sense to do so
  - Program needs to provide for tight integration of outsource resources with internal resources.

The staffing and implementation strategies described below summarize Westin's recommendations on how to organize and conduct the program.

Staffing

To implement the program recommendations WTD must manage four staffing areas:

1. Program/Project Management Staffing
2. Technical Staff
3. System Operations and Maintenance Staffing
4. External Staffing Sources.

Appendix B presents an approach for managing this program that addresses these four areas of need. The key to the recommended approach's success is for WTD to take immediate action and implement the following two recommendations:

1. Hire a Chief Information Officer (CIO) who reports directly to the WTD Manager and participates in WTD business decision making at the Section Manager level.

2. Establish a Core of Excellence (COE) group that coordinates the activities of all the technology projects included in this program, plus the technology components of the other WTD projects funded outside of this program.

The funding for the COE and supporting matrix personnel is included in each of the nine projects and 29 subprojects that make up this program. Appendix F identifies these funds at the subproject level for each of the seven project phases WTD uses in estimating the cost of projects included in its Capital Improvement Program:

1. Planning
2. Pre-Design
3. Final Design
4. Implementation
5. Construct
   - Other
   - Close Out
6. Land Acquisition
7. Contingency.

Figure ES-3 illustrates the relationship between the CIO and the COE and how they provide support to the Sections by using matrix personnel to implement the projects.

Implementation Strategy

Once WTD has organized staffing for the program, the next step is to embark on its implementation. Since there are 29 subprojects in the program spread out over the ten-year planning period, there will be ample opportunity to build implementation teams that are reassigned to multiple projects over the program's duration. By using the COE staffing approach, a number of matrix project teams can be formed to address the needs of the current calendar year projects, then increase or decrease the number of teams and their size accordingly each year. In this manner WTD will be able to handle multiple projects, with staff assigned from the Sections, but following the COE guidelines for implementation. WTD standards will be enforced, and the lessons learned from one project to another will be retained. WTD's technology expertise will grow gradually, and the matrix implementation staff will ultimately become very experienced and knowledgeable users.

Figure ES-4 illustrates the program implementation strategy envisioned which matches the implementation requirements of the program's Roadmap shown in Figure 2-1.

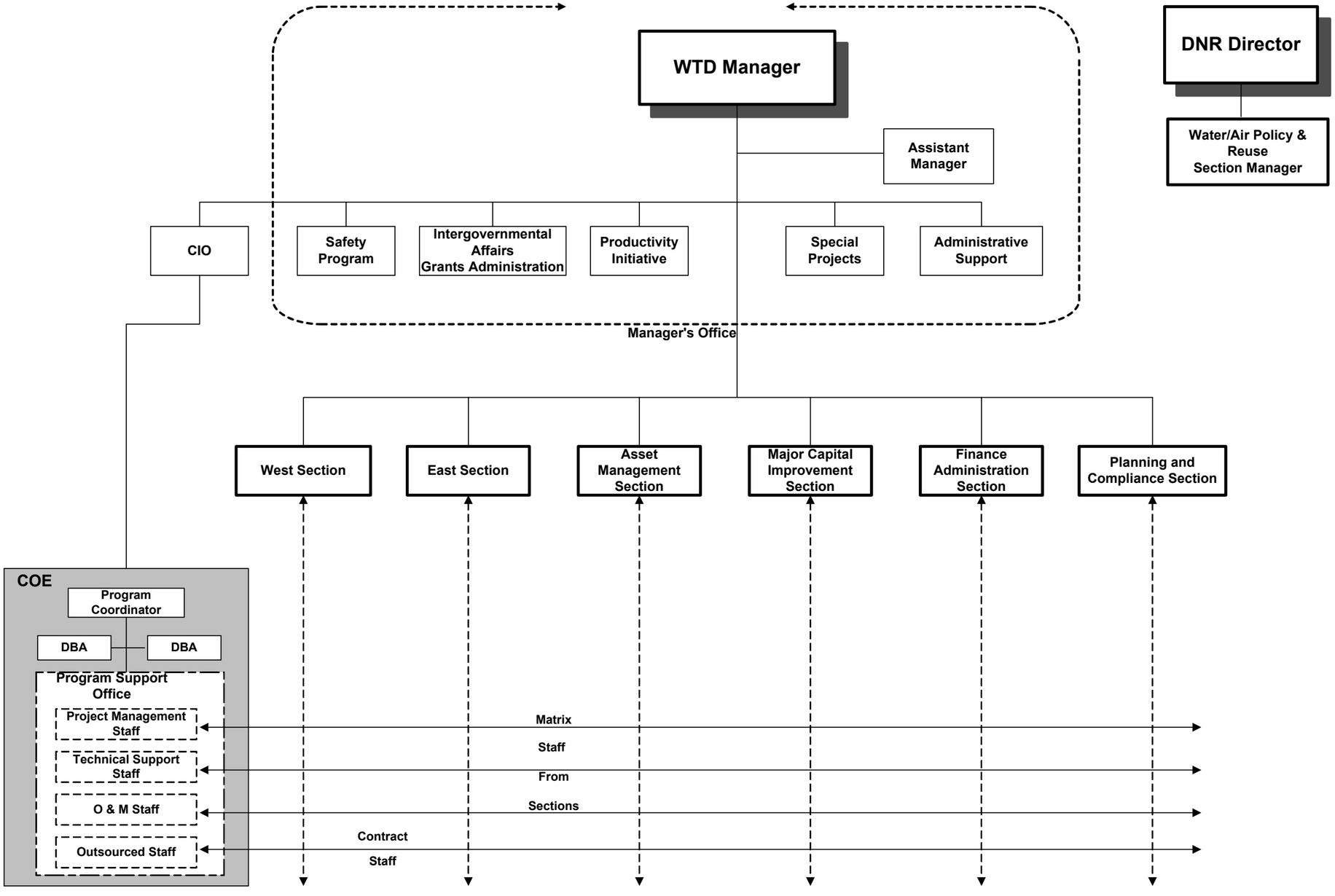
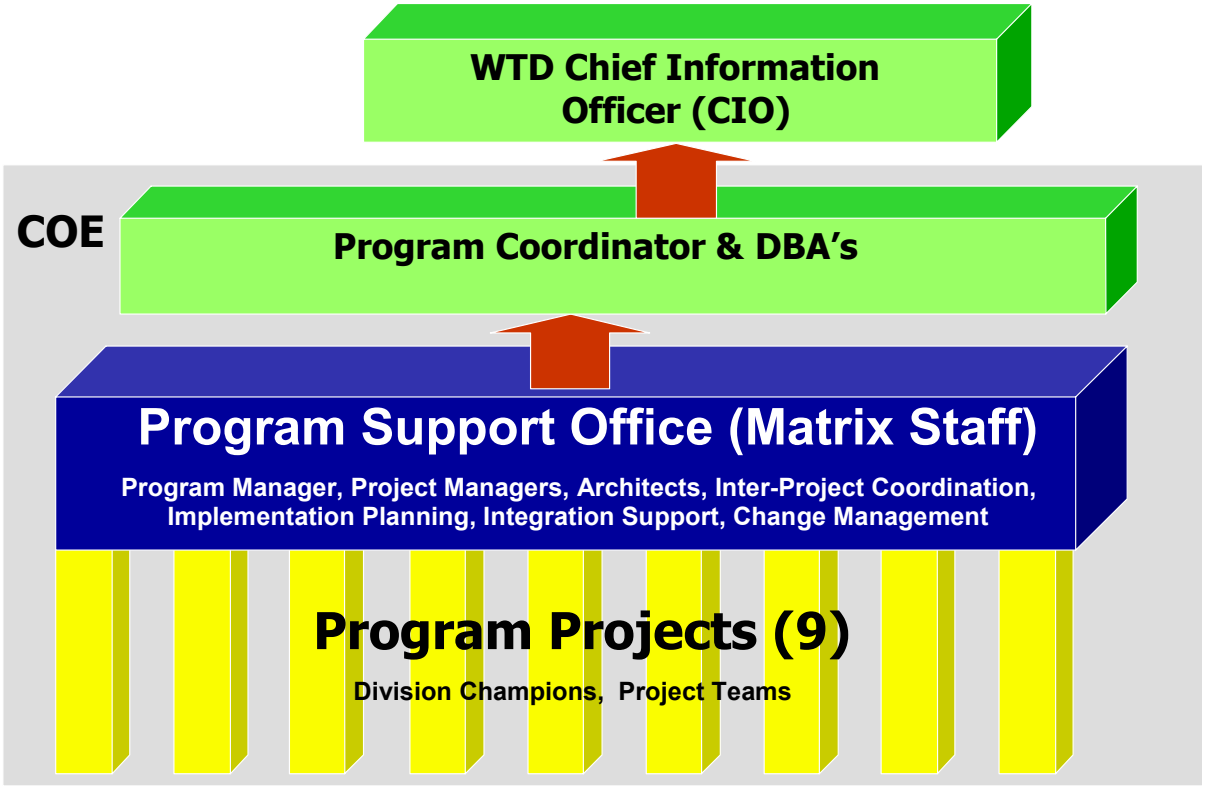


Figure ES-3: Program Organization - Core of Excellence (COE)

Figure ES-4: Program Implementation Strategy



Implementation Timeline/Results

Implementing the Master Plan recommended projects will require the initiation of several major activities as illustrated on the top half of the timeline shown in Figure ES-5. This figure also shows the timeline for outcomes that can be expected over the same ten-year period on the bottom half of the diagram. The number indicated in the legend represents each of the nine projects included in this Master Plan in the diagram.

Financial Analysis

Westin estimates that completing these nine proposed projects over the next ten years will require an incremental investment of $46 million. Cost figures are discussed in the Master Plan of this document, followed by detailed information in Appendix A: Cost Saving Benefits and Appendix F: Projects and Subprojects.

Putting this recommended investment into perspective, the Division spent $42 million building its current computing infrastructure over the last ten years, and received a significant return on its investment in the form of reduced staff growth and the ability to reduce overflows to less than one per site per year. Replacement of this investment and the addition of the new technologies needed to meet the WTD's future needs will actually cost less today when valued in 1992 dollars. It will also allow the Division to retain the savings generated from past projects as they are upgraded or replaced as part of this program.

In addition to calculating the investment required to implement the nine projects over a ten-year period, Westin also estimated the potential cost avoidance that could be anticipated over the same period. The details of these potential cost avoidance areas are provided in the Master Plan section of the document, with additional details by subproject in Appendix A: Cost Saving Benefits.

Figure ES-6: Implementation Cost provides a graphic representation of the investment requirement. This figure depicts the cost of the replacement and new projects.

The Master Plan investment recommendations match the lower capital spending imposed by the County during the first three years of the project. The plan gradually increases to a moderate investment level as it progresses. The result of a low initial capital outlay gives the plan a pay-as-you-go character, focused on the most critical projects first. The plan then invests in those projects contributing to improved business practices and positions WTD for long term competitiveness.

Conclusion

The King County Wastewater Treatment Division has established goals of becoming one of the best publicly operated wastewater utilities by 2005 and of being competitive with private sector wastewater utilities by 2010. Both of these goals are strongly supported by the Computer Systems Master Plan, as essential systems are replaced early in the program and new systems are implemented that provide the essential tools for long term growth and productivity management.

The public demand for smaller, more efficient government agencies requires WTD to do more with less; to be a lean organization with efficient staff, streamlined workflow processes and cost effective operation, maintenance and engineering services. Past technology investments have allowed the Division to meet this expectation. The goal of the Master Plan recommendations is to optimize future technology investments and to create an integrated computer infrastructure to provide staff with fast, easy and reliable access to relevant and accurate information.

The Computer System Master Plan Program Replacement Projects are required by WTD to cost-effectively complete the core business of the Division and to meet the Divisions operations goal of one overflow per year.

The New Projects are required by WTD in order to provide the new functions or services that enable the Division to streamline its work processes by use of:

- Integrated databases
- Automated workflow tools

Together, the Replacement and New Projects provide the Division with the tools to maintain its current business position and gradually improve it to meet future demands and achieve its five- and ten-year goals. Westin recommends WTD approve this Master Plan and proceed with implementing the program.

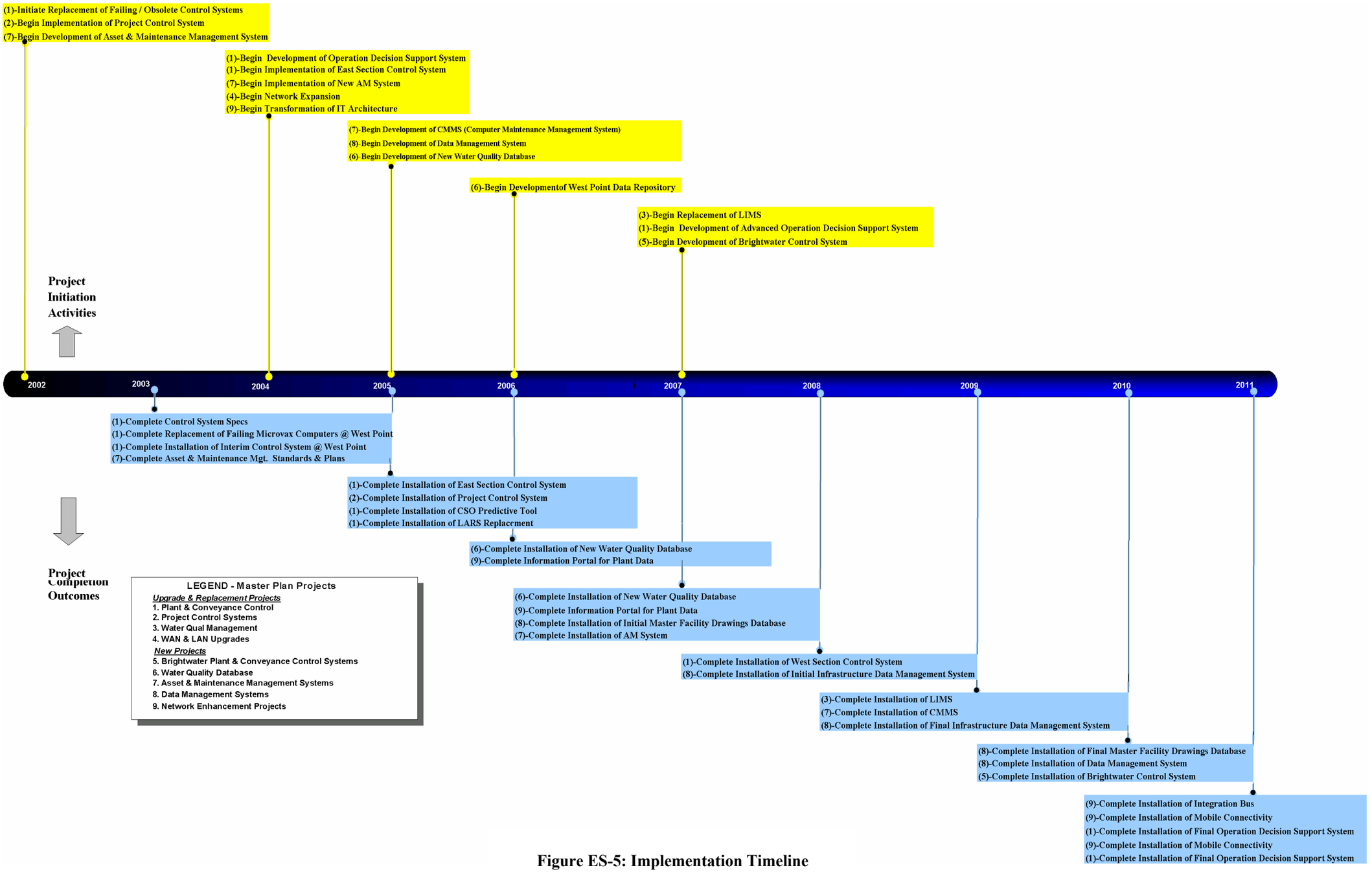
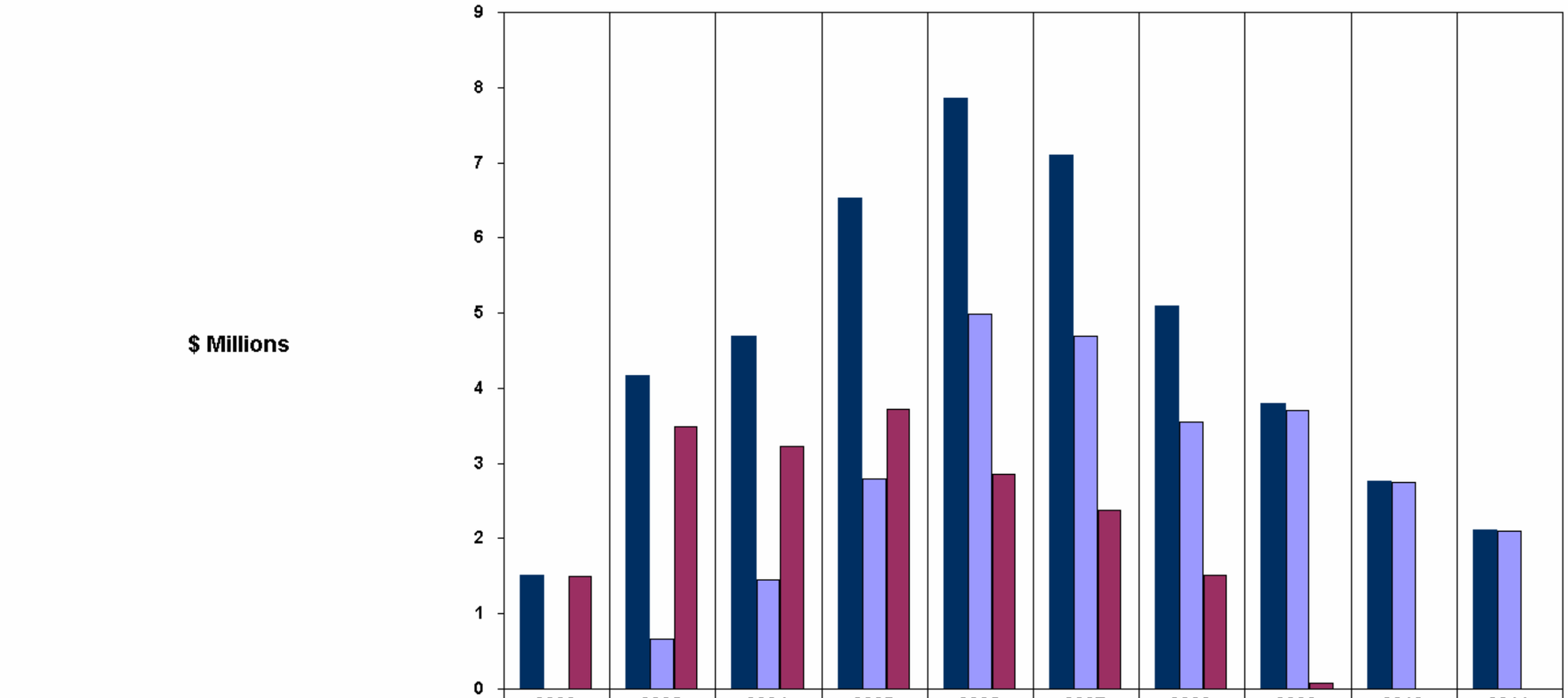


Figure ES-5: Implementation Timeline



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Annual Implementation Cost - $46M All Projects	1.50	4.16	4.68	6.51	7.85	7.08	5.08	3.78	2.76	2.10
New Projects Cost $27M	0.00	0.67	1.46	2.79	4.99	4.70	3.56	3.71	2.76	2.10
Replacement Projects Cost $19M	1.50	3.49	3.22	3.72	2.86	2.39	1.52	0.07	0.00	0.00

Figure ES-6: Program Implementation Cost

1. INTRODUCTION

Westin Engineering was retained to conduct a Computer Systems Planning Study (Study) for the King County Wastewater Treatment Division (WTD). The purpose of the Study was to:

1. Assess the condition of WTD's computer assets and determine their risk of failure.
2. Create a plan that will coordinate computer investments to create an integrated computer infrastructure.
3. Establish process standards for WTD computer projects.
4. Establish standards for WTD computer systems.

The results of this study are documented in this Computer Systems Master Plan, which consists of:

- Executive Summary
- Master Plan
- Appendix A – Cost Avoidance Benefits
- Appendix B – IT Staffing
- Appendix C – IT Standards
- Appendix D – IT Architecture
- Appendix E – Existing Condition Assessment
- Appendix F – Projects and Subprojects

This portion of the documents, the Master Plan, presents a very specific roadmap for implementing a series of nine major projects, four replacement projects and five new computer systems projects, over the next ten years. This roadmap is based on very detailed information and recommendations contained in each of the appendices.

1.1 Background

Over the past 15 years, the Division has invested nearly $80 million building and maintaining the 75 applications that make up the WTD computer infrastructure illustrated in Figure ES-1. Westin Engineering estimates that without this stated investment in technology, the budget required to run the Division would be 25 percent higher than its present level. The past investments represented sound business decisions. The Division should continue investing in information technologies by following the Study recommendations.

The evolution of the computer industry has changed the expectations and demands placed on computer systems. To meet these new requirements, the Division should complete a series of manageable projects that incrementally build the computer infrastructure by modifying, upgrading or replacing four existing computer systems and installing five new computer systems. To build a computer infrastructure in this manner requires a plan that considers the condition of existing systems, as well as the current and future needs of the Division. Standards are needed to

ensure that existing and new computer systems are able to efficiently communicate with one another and rapidly transfer information. The past has shown that without such a plan, disparate computer systems that do not form an integrated computer infrastructure will result. The Division cannot afford to make investments that do not result in an integrated computer infrastructure.

The Master Plan contains specific recommendations that will allow the Division to optimize existing and future investments in technology, thereby creating an integrated computer infrastructure. This computer infrastructure will provide management and staff with fast, easy and reliable access to relevant and accurate information.

1.2 Existing Systems

The Master Plan identifies each of the existing computer systems, as illustrated in Figure ES-1. This figure shows the upgrade and replacement priority for each system, its connectivity with other systems and how each system is currently supported. This figure clearly indicates the number of systems in need of immediate attention and the low level of system interconnectivity and integration.

2. ROADMAP

Westin Engineering recommends that WTD complete nine major projects, four replacement projects and five new computer system projects, over the next ten years. These nine projects are comprised of 29 smaller, more manageable subprojects that must be precisely coordinated to complete the overall objectives of the recommendations.

This plan will require the establishment of and adherence to standards for databases, applications, communication protocols, naming conventions, configurations and project management. These standards are necessary to achieve the optimal level of integration and to prevent the development of redundant systems. Westin determined that the lack of standards in the past was partially responsible for creating the low level of integration in the existing computer infrastructure. It is important that the standards are clear, well-documented and communicated to staff for use in implementing the recommendations.

It is also important to remember that ten years ago it would have been nearly impossible to understand the level of integration needed today or the impact of information technology on the daily operations of the Division. This lack of understanding is the secondary reason for the low level of integration in the existing computer infrastructure. Today there is a better understanding of how systems should be integrated and how computers can be used to increase productivity. Implementing the recommendations will provide the technology resources the Division needs to realize the desired increases in productivity.

The Computer System Study Implementation Program Roadmap is shown in Figure 2.1 and should be used as a guide for the implementation of the nine recommended projects. The roadmap uses a different color for each project and divides each project into subprojects. The project schedule, interdependencies and identifier numbers are also shown. The identifier numbers shown on the left side of the Roadmap are used throughout the document to identify projects and subprojects.

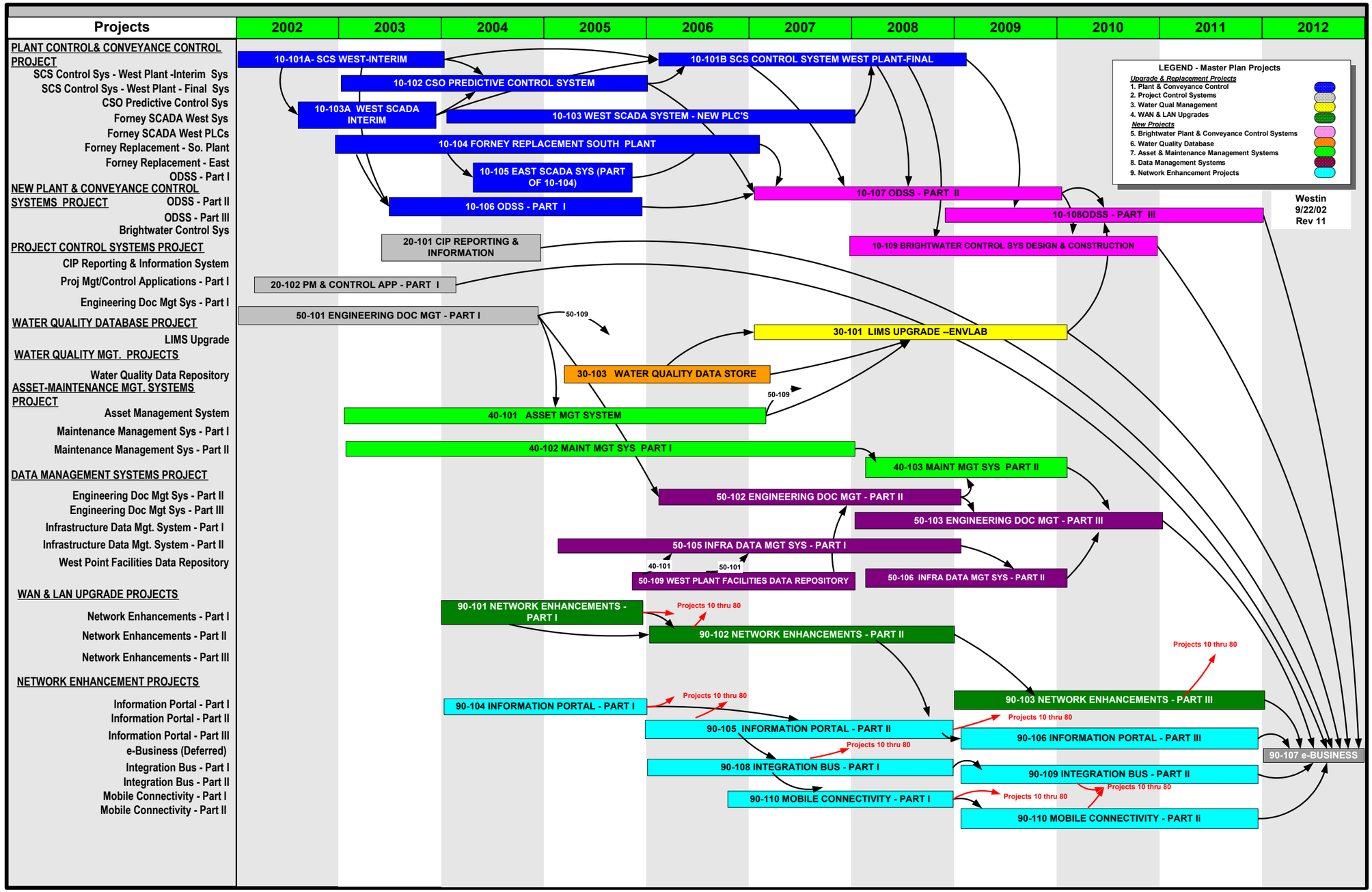


Figure 2-1: WTD Computer Systems Plan Implementation Roadmap

3. UPGRADE AND REPLACEMENT PROJECTS

The four replacement projects are presented in this section. Each of these projects is essential to the continued efficient operation of WTD, and must be implemented to avoid near term staff increases, and decrease the risk of pollution of more than one overflow per site per year in the immediate future. The four upgrade and replacement projects are as follows:

- Plant and Conveyance Control Systems (Section 3.1)
- Project Control (Section 3.2)
- Water Quality Systems (Section 3.3)
- Wide Area Network (WAN) and Local Area Network (LAN) (Section 3.4).

For each project the following information is presented:

- Risk: Potential and Consequence
- Costs: Implementation Costs and Cost Savings
- Existing System Condition
- Subprojects.

3.1 Plant and Conveyance Control Systems

The plant and conveyance control systems allow staff to operate and control the treatment plants and conveyance regulator and pump stations. This project will maintain, upgrade and replace the existing systems.

Risk: Potential and Consequence

The plant and conveyance control systems have the highest potential for failure due to obsolescence and age. These computer systems are critical to the ability of the Division to efficiently convey and treat wastewater. It would be virtually impossible to operate the West Point Treatment Plant during storm events without these systems. The small wet wells and the short response time would almost guarantee routine bypasses of untreated sewage at West Point.

Failure of the plant and conveyance control systems would:

- Require operations staff to double in size
- Require the number of plant analyst to increase by fifty percent
- Negatively impact public health and safety from overflow events
- Damage assets at the treatment plants and pump and regulators station
- Negatively impact the ability of the Division to meet regulatory reporting requirements
- Impair the Division's ability to meet the goals of becoming the best public wastewater utility in five years or of being competitive with private sector utilities in ten years.

The following computer systems have the highest potential for failure in the Division:

- Forney West Offsite Control System
- SCS West Plant Supervisory Control System
- Forney South Plant and Offsite (East) Control Systems
- LARS Water Quality Reporting System at South Plant.

Costs: Implementation

The cost to implement of this project is $15,675,000 and is summarized in the table below.

Project/Subproject Name	Total Cost	2002	2003	2004	2005	2006	2007	2008
Replacement of Existing Plant and Conveyance Control Systems	$15,675,000	$2,000,000	$2,910,000	$2,875,000	$3,480,000	$2,015,000	$1,630,000	$765,000
Interim Replacement of West Point SCS Control System	$1,600,000	$1,300,000	$300,000					
Final West Plant and Conveyance Control System	$3,195,000					$1,110,000	$1,320,000	$765,000
CSO Predictive Model	$1,785,000		$360,000	$715,000	$710,000			
Interim Replacement of West Forney SCADA Control System	$800,000	$300,000	$500,000					
Replacement of West SCADA PLCs	$2,000,000			$130,000	$780,000	$780,000	$310,000	
South Plant and East SCADA Forney Control System	$5,175,000	$400,000	$1,550,000	$1,550,000	$1,550,000	$125,000		
ODSS Part I: Replaces LARS	$1,120,000		$200,000	$480,000	$440,000			

Costs: Cost Avoidance

Failure of the plant and conveyance control systems will significantly decrease the ability of the Division to convey and treat wastewater. The worst case would require a doubling of operations staff to manually operate the offsite facilities and treatment plants.

Returning to manual operations would be an expensive step backwards for the Division and would provide only minimal control during storm events. The computerized control provided by these existing systems allows staff to efficiently manage the conveyance and treatment of wastewater during storm events and plays a significant role in reducing the number and duration of overflows. Without this computerized control the Division would not be able to meet internal or external regulatory requirements and would require a substantial budget increase to operate the offsite facilities and treatment plants.

If the current systems fail, WTD plant staff would use their creativity to find ways to circumvent the failures and to reduce the number of staff needed to manually operate the system. However, these corrective actions would take time and the degree of their success in gaining semi-automatic control of the plant and conveyance systems is unknown. The one thing that is certain is that replacement of these systems now will circumvent the impending failure situation and assure WTD of continued operation with the current level of staffing. Thus this project is providing a cost avoidance incentive.

See Appendix A for a summary of the cost avoidance from this project.

Existing System Condition

The following plant and conveyance control systems exhibit the poorest condition of any computer system in the Division:

- West Conveyance Forney Control System
- West Point Treatment Plant Supervisory Control System
- East Section Plant and Conveyance Forney Control Systems
- LARS Water Quality Reporting System at South Plant.

The above-named systems have exceeded their designed service life and replacement parts are difficult to obtain. Staff is forced to use the secondary market to obtain used parts for spares and to replace failed components.

See Appendix E for a detailed assessment of the existing condition of the equipment and systems associated with this project.

Subprojects

This project consists of the following eight subprojects. Each subproject is described in further detail in Appendix F: Projects and Subprojects.

Interim Replacement of West Point Plant Supervisory Control System (10-101A)

This subproject will upgrade the Supervisory Control System at the West Point Treatment Plant with an interim S3 Control system for each of its 13 process control areas. The current system will be replaced in a series of 13 upgrades; one process at a time until the new interim control system is in place.

Interim Replacement of West Conveyance Forney Control System (10-103A)

This subproject will replace the existing West Conveyance Forney Control System with an interim system that will free up the Forney MicroVAX computers for use at South Plant. It will be installed as an interim system that will provide conveyance control functions, flow calculations, alarm sensor detection and report generations. Then the SCADA will be upgraded into the Division standard control system developed in 10-104.

This system will use the existing TI PM550 PLCs. The TI PLC spare parts that will become available from the East Collection System PLC replacement project (now in the bid process and to be completed in 2002), will be used to extend the life of the existing West Collection TI PLCs.

South Plant & East Conveyance Forney Control System Replacement (10-104, 10-105)

This subproject has five main objectives:

1. Upgrade or replace the Forney Control System (10-104).
2. Upgrade or replace the Forney Conveyance System.
3. Combine the plant and conveyance control functions.

4. Interface the new East Conveyance System PLCs with the new South Plant Control System.
5. Establish the control system standard for the Division.

CSO Predictive Control Model (10-102)

This subproject has three main objectives:

1. Provide new hardware for the CSO software.
2. Move the CSO software to the new hardware platform.
3. Update the CSO control algorithms to reflect changes in the conveyance system.

ODSS Part I: Replaces LARS (Operations Decision Support System) – Part I (10-106)

This subproject replaces the Lab Analysis Reporting System (LARS) at South Plant and the Plant Report System at West Plant. It also provides the core technical elements to address Division-wide data analysis and reporting needs.

Replacement of West Conveyance System TI PLCs (10-103B)

This subproject replaces the West Conveyance System TI PLCs. The West Collection System TI PLCs will be replaced with the same PLCs that are selected for the East Collection System.

Final West Point Plant & Conveyance Control System (10-101B)

This subproject will replace the plant and conveyance control system at West Point with a system that meets the Division standards established in 10-104. It will have the same look and feel as the control systems at South Plant and will serve as the design basis for the new Brightwater Control systems. After completing this subproject the Division will be in the position to remotely control Brightwater on a limited basis from West Point or South Plant.

3.2 Project Control Systems

The existing project control system cannot meet the new program management and reporting requirements. The systems installed in this project will allow the Division to meet these new program requirements. The funding for a portion of this project is included in the RWSP. As a result the funds required to implement this project are not shown in the cost tables. This project is currently in progress.

The work of developing the new systems has already begun via a Program Management Services Contract with URS Construction Services. The recommendation of the Study is that URS:

- Determine the project control system requirements for all of WTD
- Establish standards for the project control systems to ensure system integration
- Reduce the total number of project control systems from the current 14 system databases to three or four systems
- Apply the computer technology architecture guidelines established in Appendix D for this project.

It is critical that the new project control computer systems be developed to be easily integrated into the WTD Division-wide computer network and to incrementally build the project control system of the future.

Risk: Potential and Consequence

The potential for failure of the existing project control systems is high. This potential failure is a result of the increased project activity related to the RWSP and the new Asset Management Section. The increased demands on the project control system will come from the following areas:

- The number of active projects
- The number of contracts and subcontracts
- The total project dollar value (billion versus millions)
- Widespread WTD personnel involvement
- Auditing required to support the RWSP Project.

This level of activity will cause the already labor intensive databases to become even more difficult to manage and will make it especially difficult to reconcile records between the various databases.

The consequences should these systems fail are high and include:

1. A lowered capacity to meet program management and reporting requirements
2. An increase in the time required to meet program management and reporting requirements.

Cost: Cost Avoidance

Detailed cost avoidance analyses were not done for this project. However, the initial review of this project indicates a potential for reduction in data entry. Verification and duplication can be achieved by improving the data sharing ability of the system and reducing the number of databases used to manage projects.

Over 250 WTD employees track the 300 active projects and 900 total projects with the project control databases. Over 1200 progress payments are processed each year and historical information exists for 1500 past projects. Financial information is manually downloaded from IBIS to produce and distribute over 300 reports each month. It is conservatively estimated that automating these manually driven tasks and eliminating disparate databases would allow the Division to avoid hiring the equivalent of two FTEs, spread across several user groups, over the next ten years. The cost avoidance associated with project control has not been included in Appendix A: Cost Saving Benefits, since this project is primarily funded through the RWSP.

Existing System Condition

Figure ES-1 shows all WTD computer applications/systems. The following applications and systems are considered part of the project control system:

- CIP List – 14 databases contained in this set of applications
  - CIP EWR
  - CIP CM Contracts
  - CIP CM Consultants
- CPS2 – Contract Payment System
- CIP Budgeting & Actual Performance
- DNR CIP Spreadsheet
- Primavera
  - Timberline and MC² – project estimating
  - Express
  - Expedition
- DW database – 17 small databases
- DDOCS – Denny Way.

The project control systems are not at a significant risk of failure and allow WTD to satisfy current contract project management and reporting requirements. However, the lack of system integration makes managing the data and the system applications time-consuming. The project control systems need to be replaced with a Division-wide set of integrated applications that require minimal manual or semi-automatic means to manage the databases.

See Appendix E for an assessment of the existing condition of the equipment and systems associated with this project. Figure E-1 illustrates the upgrade and replacement priority associated with each of the over seventy existing WTD computer systems.

Subprojects

This project consists of the following three subprojects. Each subproject is described in further detail in Appendix F: Projects and Subprojects.

CIP Reporting (20-101)

This project implements a Division-wide, Web-enabled, Capital Improvement Program (CIP) Reporting & Information System that will enable the sharing of CIP information throughout the Division. This project will improve existing workflow processes and applications used for reporting, will define reporting requirements, and will develop a Web-based reporting application.

Project Management and Control Applications – Part I (20-102)

Part I establishes consistent, Division-wide standards, procedures and workflow processes for project management and control. This project also evaluates and selects software to support the standards. Lastly, it implements at least some of the applications listed above.

Engineering Document Management – Part I (50-101)

This project establishes standards for documents and document management. It also extends the Web-enabled RWSP Engineering Document Management System for use throughout the Division.

3.3 Water Quality Systems

The water quality systems allow staff to collect, analyze and report regulatory compliance data. This project will replace the existing water quality systems.

Risk: Potential and Consequence

The failure of the water quality systems does not present a significant health and safety risk. However, these systems dramatically affect the ability of the Division to cost effectively meet the regulatory reporting requirements. A failure of these systems will negatively impact productivity.

Costs: Implementation

The cost to implement this project is $910,000 and is summarized in the table below.

Project Name	Total Cost	2002–06	2007	2008	2009
Replacement of Existing Water Quality Systems – LIMS Upgrade	$910,000		$420,000	$420,000	$70,000

Costs: Cost Avoidance

Monitoring and analyzing key process data provided by the computer system installed in this project will facilitate staff in the long-term optimization of the treatment plant processes. Less time will be required to monitor, collect and analyze data and complete daily and monthly reports. These efficiencies are estimated to result in a cost avoidance figure of $30,000 annually. The cost avoidance figures are summarized in Appendix A.

Existing System Condition

The Laboratory Information Management System (LIMS) was installed in 1999. By 2007 the system will need to be upgraded and/or replaced. Technology changes, along with changes in design methods for software applications, will make the current LIMS obsolete by 2007.

See Appendix E for an assessment of the existing condition of the equipment and systems associated with this project. Figure E-1 illustrates the upgrade and replacement priority associated with each of the over seventy existing WTD computer systems.

Subprojects

This project consists of the following subproject. It is described in further detail in Appendix F: Projects and Subprojects.

LIMS Upgrade (30-101)

This subproject will replace the LIMS at the Environmental Laboratory and create a database to collect all water quality data in the wastewater program.

3.4 Wide Area Network (WAN) and Local Area Network (LAN)

This project will upgrade the WAN and LAN as required to serve new applications. The WAN and LAN are the physical components of the computer infrastructure; the actual wires, fiber-optic cables, routers and servers that transfer data from point to point. This project is an extension of the existing business practice of maintaining and upgrading the Division's computer infrastructure. The upgrades completed in this project provide a foundation for all projects recommended in the Study.

Risk: Potential and Consequence

The existing computer infrastructure is rated as a low risk to the Division. The WAN and LAN are not at immediate risk of failure and meet the current needs of the Division. However, history indicates that the demands placed on a computer infrastructure increase over time. To date, the computer infrastructure has been continually upgraded to meet the increasing demands of the Division. The WAN and LAN projects are a continuing process and ensure that the computer infrastructure will grow in unison with the Division's needs.

Approximately 75 percent of WTD staff is dependant upon computers and the computer infrastructure to complete their daily work assignments. Therefore, the consequence of a failure is high.

Costs: Implementation

The cost to implement this project is $2,965,000 and is summarized in the table below.

Project/ Subproject Name	Total Cost	2006	2007	2008	2009	2010	2011
Existing LAN & WAN Upgrades	**$2,225,000**	**$400,000**	**$345,000**	**$400,000**	**$345,000**	**$400,000**	**$335,000**
Network Enhancements: Part I	$745,000	$400,000	$345,000				
Network Enhancements: Part II	$745,000			$400,000	$345,000		
Network Enhancements: Part III	$745,000					$400,000	$345,000

Costs: Cost Avoidance

No cost avoidance has been identified for this project.

Existing System Condition

The existing networks are very well maintained and are satisfying the majority of WTD user needs. Sufficient bandwidth is available to allow reasonable response times to user requests, except for a few deficient links that are currently being addressed. It is a very stable system that is heavily used, as most staff are dependent upon the system to complete their primary responsibilities.

See Appendix E for an assessment of the existing condition of the equipment and systems associated with this project. Figure E-1 illustrates the upgrade and replacement priority associated with each of the over seventy existing WTD computer systems.

Subprojects

This project consists of the following three subprojects. Each subproject is described in further detail in Appendix F: Projects and Subprojects.

Network Enhancements – Part I (90-101)

The Network Enhancements subproject will be completed in three phases referred to as Part I, Part II, and Part III. Part I will implement the following improvements to the Division's LANs and WAN:

- Install Gigabit Ethernet at each of the major facilities within the Division
- Provide the foundation for migration to Gigabit and 10 Gigabit Ethernet;
- Connect all major Division facilities to the WAN backbone
- Implement initial wireless network pilot within the Division

Network Enhancements - Part II (90-102)

Part II will expand the Division WAN bandwidth (i.e., I-NET bandwidth utilized by the Division) from the existing OC-3 level to a minimum required level of OC-48.

Network Enhancements - Part III (90-103)

Part III will further expand the Division WAN bandwidth to OC-156 or higher.

4. NEW COMPUTER SYSTEM PROJECTS

The following five new computer system projects are tactical projects that are intended to support efficient operations of the Division in the near future and provide the technology tools to meet the computer needs of 2006-2011. These projects will enable WTD to better manage its assets, create up-to-date master facility documentation, enhance its networks, and streamline its work processes. They will contribute significantly toward realizing the Productivity Initiative. The five new computer system projects are as follows:

- New Plant and Conveyance Control Systems
- Water Quality Database
- Asset and Maintenance Management Systems
- Data Management Systems
- Network Enhancement.

For each project the following information is presented:

- Risk: Potential and Consequence
- Costs: Implementation Costs and Cost Savings
- Existing System Condition
- Subprojects.

4.1 New Plant and Conveyance Control Systems

This project will integrate the computer systems associated with the Brightwater Treatment Plant into the existing plant and conveyance control systems that are being upgraded and replaced. The control system standards and the level of remote control desired will be used to determine the control system for the Brightwater plant.

Note: The Brightwater plant and conveyance control systems are funded in the RSWP Budget and are not included in this report.

This project will also extend the initial capabilities developed in LARS and use operations and management decision support tools to create a Division-wide Operational Decision Support System (ODSS). The ODSS is a tool that uses the information in the water quality database, CSO modeling data and other operational databases to assist management and plant staff in the daily operations of the plant and conveyance control system. The information in this system will be used in the decision making process to optimize operations at the treatment plant and to generate regulatory reports.

Risk: Potential and Consequences

There are two potential risks that will be addressed with the Brightwater plant and conveyance control system:

1. The integration of the Brightwater plant and conveyance control systems into existing systems
2. The ability to remotely control the Brightwater Treatment Plant.

The goal of this project is to resolve these risks. The risks have been identified, but overcoming them will be difficult. The potential for failure, therefore, is considered medium.

The consequences should these issued not be resolved are high since remote control will be nearly impossible if the Brightwater control systems are not integrated with the existing system Without the ability to remotely control Brightwater the cost savings will not be realized.

The ODSS is a new system that will collect information from various sources and allow users to organize, analyze and report the information needed to help staff optimize the wastewater treatment process. Without this system, project staff will continue to spend more time obtaining data than analyzing data. The potential for continued inefficiencies in obtaining data is high if this project is not completed.

The consequences associated with this project are not related to public health and safety, but to productivity. As the plant and conveyance systems grow, the data associated with those systems also grows. Obtaining this data can be time-consuming, but the ODSS can cut data acquisition time by 25 percent.

Costs: Implementation

The cost to implement this project is $1,480,000 and is summarized in the table below. The Brightwater plant and conveyance control systems are funded in the RSWP Budget and are not shown below.

Project/Subproject Name	Total Cost	2002–06	2007	2008	2009	2010	2011
New Plant and Conveyance Control Systems	**$1,480,000**		**$130,000**	**$130,000**	**$470,000**	**$375,000**	**$375,000**
ODSS Part II	$355,000		$130,000	$130,000	$95,000		
ODSS Part III	$1,125,000				$375,000	$375,000	$375,000
Brightwater Plant and Conveyance Control Systems	$0						

Costs: Cost Avoidance

Operations costs can be reduced at the Brightwater Treatment Plant by using a combination of local and remote control. Depending on the extent of remote control used, the number of shifts, and number of operators, between one and four FTEs per day could be saved over the life of the plant by using remote operations.

Implementing the ODSS Part II can reduce the time-consuming task of obtaining, verifying and publishing data by 25 percent. This increased productivity equates to approximately 1000 hours per year of staff time that can be used to complete other assignments once this project is completed. These efficiencies are estimated to result in a cost avoidance figure of $30,000 annually. The cost avoidance figures are summarized in Appendix A.

The cost avoidance associated with remotely controlling Brightwater is not included.

Existing System Condition

The Brightwater plant and conveyance control systems currently do not exist. The design will follow the standards established in the existing plant and conveyance control system projects to ensure system integration.

LARS will have been replaced by the time the ODSS Part II and Part III are started. These subprojects are an extension of LARS and will provide additional functionality.

Subprojects

This project consists of the following four subprojects. Each subproject is described in further detail in Appendix F: Projects and Subprojects.

Brightwater Plant and Conveyance Control System (10-109)

The Brightwater plant and conveyance control system project will use systems similar to those found at South Plant and West Point. The instrumentation and control design will incorporate functions common to all three treatment plants. This subproject includes the design and procurement of the operator workstations, the historical data system, equipment to interface to the existing field controllers, plant instrumentation, design and installation of the communication system that links the control system components, and the support computer structure (servers) to operate the control system.

Operations Decision Support System Project - Part I (10-106)

This subproject is to be completed in three phases. Part I will replace the existing LARS and is completed in the Plant and Conveyance Control Replacement Project.

Operations Decision Support System Project - Part II (10-107)

This subproject provides the tools needed to effectively plan, schedule, and manage plant and offsite facilities by providing the necessary operations decision support information in a timely manner. The information required for effective operations decision support is currently stored in a wide variety of disparate databases, which will be used to create a uniform common database of certified information which is readily available to users via Web-based tools. Part II provides a centralized reporting system for the Predictive CSO derived data.

Operations Decision Support System Project - Part III (10-108)

This subproject will provide the Brightwater plant personnel with the required reporting and analytical applications, as well as integrate them with existing applications.

4.2 Water Quality Database

The new water quality database will serve as the warehouse for all water quality data collected in the Wastewater Program. It will provide standards for collecting, storing and reporting water quality data. It will be a certified database with quality data. Internal and external staff will use the information in the database to produce daily, weekly, monthly and annual reports.

Risk: Potential and Consequence

The water quality database was rated as a medium risk area. The water quality data is currently being stored successfully at the plants and environmental laboratories. The systems being used to store this data are in good condition and have a low potential for failure.

The data exists today, but can be time-consuming to retrieve from the current databases. Generally this is data which has not gone through a purging, verification and certification process (except at the environmental lab). What does not exist today is a centralized source of certified data on biological and chemical analyses completed by the Division's various process laboratories as well as by the Environmental Laboratory which everyone can access easily to perform their work. It now takes a great deal of effort to obtain the needed analytical information being sought for whatever water quality related issue is being analyzed. The risk lies in the adequacy and timeliness of current analyses, and its impact on WTD decision making.

Costs: Implementation

The cost to implement this project is $1,330,000 and is summarized in the table below.

Project Name	Total Cost	2002–04	2005	2006
New Water Quality Database	$1,330,000		$665,000	$665,000

Cost: Cost Avoidance

The cost avoidance associated with this project results from the deployment of water quality data over the Web and the increased productivity in creating water quality reports throughout the Wastewater Program. This increased productivity equates to 1000 hours of staff per year that will not need to be hired over the next ten years once this project is completed.

This project will only minimally impact daily operations. The increased productivity of 1000 hours per year primarily results from efficiencies in the completion of reports that require data to

be collected from different areas – streams, wetland, soils, fish habitat – and that require the analysis of months or years worth of data.

Existing System Condition

The existing water quality databases cannot communicate with each other. The databases often contain conflicting data and sometimes lack a clear certification process to ensure the accuracy of the data. This combination of circumstances makes it difficult to efficiently produce accurate, high quality reports and to make timely operations and maintenance decisions. The users need easy, fast and reliable access to this information in a format that is user friendly. Extracting this information from existing databases can be time-consuming and difficult and can be a source of significant labor hours.

See Appendix E for an assessment of the existing condition of the equipment and systems associated with this project. Figure E-1 illustrates the upgrade and replacement priority associated with each of the over seventy existing WTD computer systems.

Subprojects

This project consists of the following subprojects. Each subproject is described in further detail in Appendix F: Projects and Subprojects.

Water Quality Data Repository (30-103)

The Water Quality Data Repository will provide a centralized database for certified biological and chemical water quality data completed by the Environmental Laboratory and the various process laboratories in the wastewater program. A Web-based application will be deployed so that this laboratory data can be accessed and utilized for decision-making purposes. The data repository will provide the end-users with easy, timely and reliable access to water quality data collected throughout the wastewater program. In addition, this project will provide end-users with a tool to perform data analysis and allow data to be automatically downloaded into formatted spreadsheets.

4.3 Asset and Maintenance Management Systems

The Asset and Maintenance Management Systems Project will provide the computer systems required for the successful implementation of the new Asset Management Section.

Risk: Potential and Consequence

The potential for failure of the existing asset and maintenance management systems is high. The potential failure is the result of the increased demands being placed on the existing Mainsaver and R2D2 databases. The existing systems are not technically capable of meeting the anticipated needs of Asset Management Program.

The consequences, should this project not be completed, do not impact public heath and safety but are still rated high and include:

- The inability of the Asset Management Section to implement effective asset and maintenance management techniques
- The inability to optimize and streamline the asset and maintenance management programs
- Failure to incur the cost savings associated with this application.

Costs: Implementation

The cost to implement this project is $6,205,000 and is summarized in the table below.

Project/ Subproject Name	Total Cost	2003	2004	2005	2006	2007	2008	2009	2010
New Asset & Maintenance Management Systems	**$6,205,000**	**$665,000**	**$1,125,000**	**$1,390,000**	**$1,140,000**	**$790,000**	**$185,000**	**$550,000**	**$360,000**
Asset Management System	$1,950,000	$400,000	$600,000	$600,000	$350,000				
Maintenance Mgt. System: Part I	$3,160,000	$265,000	$525,000	$790,000	$790,000	$790,000			
Maintenance Mgt. System: Part II	$1,095,000						$185,000	$550,000	$360,000

Costs: Cost Avoidance

New or modified asset and maintenance management programs that establish optimal levels of maintenance and that streamline asset replacement are actually responsible for any increases in productivity, streamlining of workflow processes and optimizing asset replacement schedules. The new asset and maintenance management systems provide the tools to implement new or modified programs.

The cost avoidance associated with this project is estimated at $8,700,000, as summarized in Appendix A. This cost avoidance is the result of a two to three percent per year reduction in the annual asset and maintenance management budget, which was estimated at $30,000,000.

Existing System Condition

The Mainsaver computer system was originally installed to track maintenance work orders. The needs resulting from the creation of the Asset Management Section are anticipated to be significantly higher than the capabilities of Mainsaver. The system is of concern, not only because physical components are failing, but also because the system cannot meet the anticipated needs of the Division in its current configuration.

R2D2 was developed as a tool that would download asset data from Mainsaver and analyze that data to create an asset replacement list. A lack of data in Mainsaver has prevented R2D2 from successfully accomplishing its intended task. Additional data would need to be inputted into Mainsaver for R2D2 to create a useful asset replacement list. However, even with R2D2 running

optimally, the Asset Management Section would not have all the tools needed to be successful at managing Division assets.

A well-designed and integrated computer system is needed to collect and analyze the data required to implement a successful asset and maintenance management program. Mainsaver and R2D2 were installed to complete smaller, more specific tasks and were not intended to meet all the needs now being envisioned for the Asset Management Program. Mainsaver and R2D2 may be part of the final computer system, but alone they are not a viable solution.

See Appendix E for an assessment of the existing condition of the equipment and systems associated with this project. Figure E-1 illustrates the upgrade and replacement priority associated with each of the over seventy existing WTD computer systems.

Subprojects

This project consists of the following four subprojects. Each subproject is described in further detail in Appendix F: Projects and Subprojects.

Asset Management System (40-101)

Effective asset management requires significant utilization of information technology. The thrust of this project is to implement an Asset Management System that enables the Division to conduct effective asset management to:

- Optimize asset life
- Reduce unnecessary maintenance
- Smooth year-to-year CIP spending
- Improve asset and system reliability.

Maintenance Management System - Part I (40-102)

This subproject implements a Division-wide Computerized Maintenance Management System (CMMS) to support the Asset Management Program. It has yet to be decided if the existing CMMS software will be modified to better fit the needs of the Division or whether a completely new CMMS software package will be selected. Nevertheless, a thorough evaluation and selection process will be conducted to ensure that the future needs of the Division are met.

The Division needs to address a number of urgent matters with regard to its maintenance management system. First, the Division needs to establish consistent, Division-wide, maintenance and work management standards, procedures and work processes to guide the effective implementation of a CMMS. Second, the Division has new requirements from outside agencies to report on all maintenance activities as they relate to the condition of Division facilities and equipment. These needs are addressed by this subproject, which consists of three distinct efforts delineated here as Part I, Part II, and Part III.

Part I establishes consistent, Division-wide standards, procedures and work processes for maintenance and work management. This step also evaluates the software required to support

the newly established standards, procedures and work processes. During Part I, a Web-based CMMS as well as various maintenance and work management applications will be deployed.

Maintenance Management System Project - Part II (40-103)

Part II implements automated, real-time, data-level integration of the CMMS to other information systems such as Finance, Human Resources, Inventory Control, Engineering Document Management, CAD/GIS, and the Operations Decision Support System.

Maintenance Management System - Part III (40-104)

Part III falls outside the ten-year period covered in the Master Plan. The description of Part III is in Section 5: Deferred Projects.

4.4 Data Management Systems

The Data Management Systems Project will provide the computer systems to manage the documents, specifications and drawings needed to complete the business of the Division. The project will complete this objective by creating the following applications and standards for maintaining them:

- Engineering Document Management System – Master Facility Drawings
- Wastewater Program GIS Database
- GIS-enabled applications via the Information Portal
- West Point Plant Facilities Data Repository – CAD Drawings.

Risk: Potential and Consequence

The potential for failure of the existing data management systems has been rated as medium. This rating reflects the fact that the existing paper document management systems is working and allows staff to meet document management requirements. The medium potential is warranted because the additional demands resulting from the RWSP may overload the existing paper system.

The consequences of not completing this project have also been rated as medium. This rating reflects the fact that staff will continue to complete the business of the Division without the systems, but takes into account the significant inefficiencies of the existing system and cost saving that can be achieved by completing this project.

Eventually, the Division needs to tackle the problem of efficiently maintaining the project documents, specifications and drawings. The current system is inefficient and time-consuming. The projects related to the RWSP will significantly increase the amount of documentation and further exacerbate the problems with the existing system.

Costs: Implementation

The cost to implement this project is $6,720,000 and is summarized in the table below. The subproject, Engineering Document Management System - Part I, is currently underway and being completed under the scope of the RWSP Project Services Contract with URS. Therefore, the dollars needed to complete that subproject have not been included in the table below.

Project/Subproject Name	Total Cost	2005	2006	2007	2008	2009	2010
New Data Management Systems	**$6,720,000**	**$325,000**	**$1,720,000**	**$1,875,000**	**$1,340,000**	**$1,160,000**	**$300,000**
Engineering Doc. Mgt.: Part I	$0						
Engineering Doc. Mgt.: Part II	$620,000		$155,000	$310,000	$155,000		
Engineering Doc. Mgt.: Part III	$1,450,000				$425,000	$725,000	$300,000
Infrastructure Data Mgt.: Part I	$1,930,000	$325,000	$640,000	$640,000	$325,000		
Infrastructure Data Mgt.: Part II	$870,000				$435,000	$435,000	
West Point Facilities Data Repository	$1,850,000		$925,000	$925,000			

Costs: Cost Avoidance

The cost savings associated with this project primarily result from a reduction in:

- The number of change orders caused by inaccurate as-built drawings
- The time needed to obtain project documents, O&M manuals, specifications and drawings
- The time needed to complete contract drawings.

The cost avoidance from the reduction in change orders is equal to a five percent reduction in total change orders and more than a 75 percent reduction in change orders resulting from inaccurate as-built drawings. Westin estimates this reduction at $30,000 per year, based on the current level of capital projects.

The productivity gains resulting from this project will allow the Division to meet the increased data management demands resulting from the RWSP with a smaller increase in staff than would be required without the computer systems. Westin Engineering estimates that the Division can avoid hiring two new Engineering and CAD FTEs over the next ten years by completing this project. However, it must be noted that additional staff would be needed to complete the as-building necessary to make the system operational. The staff required to complete the as-building could easily be out-sourced.

Existing System Condition

The existing data management systems suffer from a lack of standards, integration and automation. The mainly paper-based systems used to store O&M manuals, project documents, specifications and drawings are in good condition but the system is inefficient, redundant and often inaccurate. The fact that the O&M manuals, drawings and specifications are maintained separately at three locations – South Plant, West Point and the King Street Center – exacerbates the problem.

The system being used at South Plant is the most effective and may be used as a guide to build the new data management systems.

See Appendix E for an assessment of the existing condition of the equipment and systems associated with this project. Figure E-1 illustrates the upgrade and replacement priority associated with each of the over seventy existing WTD computer systems.

Subprojects

This project consists of the following nine subprojects. Each subproject is described in further detail in Appendix F: Projects and Subprojects.

Engineering Document Management System - Part I (50-101)

The Engineering Document Management System will be implemented in four phases, referred to as Part I, Part II, Part III, and Part IV. Part I establishes document management standards and moves the Division from the existing paper management system to an electronic system. This project is currently being completed by URS under the RWSP Program Management Services Development Contract and is included in the Project Control Replacement Project.

Engineering Document Management System - Part II (50-102)

Part II upgrades the existing AutoCAD system to the newest Web-enabled version to enable the viewing of dynamic CAD maps by appropriate staff throughout the Division.

Engineering Document Management System - Part III (50-103)

Part III implements a Web-based application – to be deployed via the Information Portal – for the viewing and collaborative review and editing of CAD drawings.

Engineering Document Management System - Part IV (50-103)

Part IV falls outside the ten-year period covered in the Master Plan. The description of Part IV is in Section 5: Deferred Projects.

Infrastructure Data Management System - Part I (50-105)

The implementation of a GIS-centric Infrastructure Data Management System is to take place in four phases, referred to as Part I, Part II, Part III, and Part IV. Part I implements the Wastewater Program GIS Database, including database design, data standards, and data conversion. The GIS Database is to be hosted by the GIS Team, which is a part of the IT group of the Department of Natural Resources (DNR).

Infrastructure Data Management System - Part II (50-106)

Part II implements an initial series of priority GIS-enabled applications via the Information Portal. The applications implemented in this step will support asset and maintenance management.

Infrastructure Data Management System - Part III (50-107)

Part III falls outside the ten-year period covered in the Master Plan. The description of Part III is in Section 5: Deferred Projects.

Infrastructure Data Management System - Part IV (50-108)

Part IV falls outside the ten-year period covered in the Master Plan. The description of Part IV is in Section 5: Deferred Projects.

West Point Plant Facilities Data Repository (50-109)

This project will complete the as-built CAD drawings for the West Point Treatment Plan. It is assumed that much of the labor associated with completing these drawings will be out-sourced.

4.5 Network Enhancement

The WAN and LAN are the physical components of the computer infrastructure; the actual wires, fiber-optic cables, routers and servers that allow data to be transferred from point to point. This project will upgrade these components as required to serve new applications. Additionally, new technologies will be introduced to the network allowing it to function more efficiently and incorporate:

- The Information Portal
- The Integration Bus
- Web access to data
- Mobile communications Interface to INET.

Increased bandwidth will allow for full use of video conferencing and other media requiring significant network resources.

Risk: Potential and Consequence

This project has been rated a medium potential for failure because the existing system is robust and is keeping pace with current WTD bandwidth needs. However, since the recommended projects have larger bandwidth requirements these needs will expand and this area can quickly become a high-risk area.

The consequences of an overloaded network include:

- More network downtime
- Slower network response time
- The inability to add applications.

Costs: Implementation

The cost to implement this project is $10,975,000 and is summarized in the table below.

Project/Subproject Name	Total Cost	2004	2005	2006	2007	2008	2009	2010	2011
Network Enhancement Project	**$10,975,000**	**$330,000**	**$410,000**	**$1,465,000**	**$1,900,000**	**$1,900,000**	**$1,530,000**	**$1,720,000**	**$1,720,000**
Information Portal: Part I	$740,000	$330,000	$410,000						
Information Portal: Part II	$1,935,000			$645,000	$645,000	$645,000			
Information Portal: Part III	$1,205,000						$275,000	$465,000	$465,000
Integration Bus: Part I	$1,815,000			$605,000	$605,000	$605,000			
Integration Bus: Part II	$1,815,000						$605,000	$605,000	$605,000
Mobile Connectivity: Part I	$1,515,000			$215,000	$650,000	$650,000			
Mobile Connectivity: Part II	$1,950,000						$650,000	$650,000	$650,000

Cost: Cost Avoidance

The cost avoidance associated with this project results from not hiring 15 FTEs. This represents $918,000 per year over the next ten years. These savings are made possible by removing the information access roadblocks that exist today and placing the information quickly into the right user hands without a dependency on analysts. The efficiency of WTD staff will increase and their overall effectiveness will gradually provide the work equivalent of up to 15 additional resources over the next ten years.

Workflow tools are very effective in an integration bus environment and will be the key to even greater efficiency improvements in the future.

The projected cost avoidance is well within the range of those seen in other industries and reported by various research organizations such as the Gartner Group. For instance, in a survey of telecommunications companies that have implemented an Information Portal and an Integration Bus, the overall revenue increases were on the order of 30 to 40 percent annually, with cost savings on the order of 15 percent of total labor costs.

The total cost avoidance resulting from completing this project is estimated at $3,213,000 and is summarized in Appendix A. These savings contribute to WTD's overall long term stability and goal of becoming competitive with the private sector utilities in ten years.

Existing System Condition

As stated in the Replacement WAN/LAN Project, the current network is healthy and is satisfying current Division needs. However, the network enhancements recommended in this project are essential to successfully implementing the Master Plan. The WAN/LAN and Network Enhancement projects allow the enterprise data sharing strategy recommended in the Study to be implemented.

See Appendix E for an assessment of the existing condition of the equipment and systems associated with this project. Figure E-1 illustrates the upgrade and replacement priority associated with each of the over seventy existing WTD computer systems.

Subprojects

This project consists of the following seven subprojects, which are described in further detail in Appendix F: Projects and Subprojects.

Information Portal - Part I (90-104)

The Information Portal Project will be implemented in three phases, referred to as Part I, Part II, and Part III. Part I will replace the existing Division intranet and Web technologies and practices. It will make the WTD intranet the channel for all communications among WTD staff and will make the WTD Internet site the channel for all communication between WTD staff and external agencies and contractors. Further, it will implement the software tools required to efficiently publish and share data and deploy new applications over the Web.

Part I includes implementing prototype Web-based Information Portal applications for CIP reporting, data graphing, data analysis, static viewing of Balanced Scorecard data, static viewing of GIS maps, and viewing of historical data from IBIS and PeopleSoft. Part I also links the Information Portal to the basic messaging capabilities of the Integration Bus.

Information Portal - Part II (90-105)

Part II deploys applications for asset management, maintenance management, project management and control, operations decision support, and preliminary budget tracking via the Information Portal. It also links the Information Portal to the data integration capabilities of the Integration Bus.

Information Portal - Part III (90-106)

Part III deploys applications for engineering document management, budget reporting and information, dynamic viewing of Balanced Scorecard information, and dynamic viewing of GIS maps. It also links the Information Portal to the workflow automation capabilities of the Integration Bus

Integration Bus - Part I (90-108)

The Integration Bus Project will be implemented in two phases referred to as Part I and Part II. Part I implements the data-level integration components of the Integration Bus, enabling priority applications within WTD to access WTD databases regardless of the data structure, data format, or database technology.

Integration Bus - Part II (90-109)

Part II implements the workflow automation components of the Integration Bus. Workflow automation will increase the effectiveness and reliability of application-to-application links and reduce the number of manual data transfers across applications.

Mobile Connectivity - Part I (90-110)

Mobile Connectivity will be implemented in three phases referred to as Part I, Part II, and Part III. Part I implements the mobile capabilities of the Information Portal, delineates WTD wireless devices and configures those devices to access the Information Portal.

Mobile Connectivity - Part II (90-111)

Part II implements enhanced mobile information distribution capabilities, especially graphical information such as CAD and GIS. Part II also implements 3rd-Generation mobile devices within WTD.

Mobile Connectivity - Part III (90-112)

Part III falls outside the ten-year period covered in the Master Plan. The description of Part III is in Section 5: Deferred Projects.

5. DEFERRED PROJECTS

The following subprojects have been deferred because of a low priority ranking and the financial constraints of the Division. The deferred subprojects remain in the Study documentation to preserve the scope of work of the subprojects and to allow them to be reviewed in conjunction with Master Plan every three years. The review process will determine if the deferred subprojects should be implemented during the updated Master Plan.

The deferred subprojects are described briefly below. Each deferred subproject is described in further detail in Appendix F: Projects and Subprojects.

5.1 Project Control Systems

As part of the Master Plan recommended projects, Part I establishes consistent, Division-wide standards, procedures and work processes for project management and control. It also evaluates and selects software to support the standards. Finally, it implements at least some of the applications listed in the original discussion of Project Control Systems. The following deferred subprojects extend this capability by providing data-level integration of many of the business functions within the Division, and implements workflow tools to expedite decision making and automate many work processes.

Project Management and Control Applications Part II (20-103)

Part II implements data-level integration of the Project Management & Control Applications to other information systems such as Finance, Human Resources, Inventory Control, Engineering Document Management, CAD/GIS, and others.

Project Management and Control Applications Part III (20-104)

Part III automates many of the data-level integration links and some of the significant workflow(s) associated with the Project Management & Control Applications, especially those associated with coordination, collaboration, review and approval, and document routing.

5.2 Water Quality Systems

PIMS - Septage Bio-solids Integration (30-102)

This subproject uses the Information Portal and the Integration Bus to integrate LIMS, PIMS, Septage, Bio-solids, and GIS. It will allow data from these applications to be used by Division staff and outside agencies.

5.3 Asset and Maintenance Management Systems

Maintenance Management System Project - Part III (40-104)

Part III automates the various workflows associated with the CMMS and integrates CMMS with other information systems. This subproject will improve coordination, document routing and the review and approval process associated with maintenance management.

5.4 Data Management Systems

Engineering Document Management System - Part IV (50-103)

Part IV implements document version control deployed via the Information Portal and automates workflows associated with engineering document management.

Infrastructure Data Management System - Part III (50-107)

Part III implements an additional series of GIS-enabled applications, making use of both the Information Portal and the Integration Bus. This subproject will allow staff to obtain data in a geo-spatial environment from the PIMS, Repair/Replacement, Facility Inspection and Inflow & Infiltration databases.

Infrastructure Data Management System - Part IV (50-108)

Part IV allows staff to use modeling applications via the Information Portal and the Integration Bus.

5.5 Training Support Systems

WTD Employee Information System (60-101)

This subproject will Web-enable the WTD Employee Information System. This subproject will improve accessibility and response time of the database.

5.6 Business Support

County Finance and HR Integration – Part I (70-101)

Information provided by the County's Finance and HR systems is essential to the effectiveness of Division operations. There are a number of Division information systems that should be integrated with the County's Finance and HR system. The Integration Bus and the Information Portal will expand and automate access to the County Finance and HR systems.

The integration of County Finance & HR systems with Division information systems will be implemented in two phases referred to as Part I and Part II. Part I implements data-level integration via the Integration Bus and the Information Portal.

County Finance and HR Integration – Part II (70-102)

Part II implements workflow automation via the Integration Bus and the Information Portal.

5.7 Productivity Metrics

Budget Planning & Tracking System (80-101)

This subproject implements a Division-wide system to provide information and coordination support for the Finance and Administration Section. The subproject will provide the tools to improve the WTD budget process, including the ability to complete budget updates, analysis and tracking via the WTD Information Portal.

Productivity Metrics (80-102)

The Productivity Metrics Reporting & Information System supports the management of the Productivity Initiative. By embedding this executive reporting system within the WTD Information Portal, relevant productivity data can be assembled from a variety of data sources throughout the Division and other agencies and be presented to Division management in highly visual formats to support the decision-making process. In this way, the status and progress towards Productivity Initiative goals can be viewed and assessed. Relevant business data will be rolled up into a dynamic Balanced Scorecard to be viewed by authorized personnel. This system could also be used to present benchmarking data in a similar manner.

5.8 Network Enhancement

e-Business / e-Commerce / e-Procurement Project (90-107)

This project provides the tools to enable staff to procure supplies over secure Internet links.

Mobile Connectivity - Part III (90-112)

Part III extends the capabilities of the wireless devices throughout the Division.